

# CHORIZO : COLOUR PARAMETERS EVOLUTION DURING RIPENING

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## SUMMARY

Colour parameters evolution during "Chorizo" process were evaluated, CIE  $L^*a^*b^*$ , pigment nitrosation and pigment discolouration were measured for different diameters and zones,  $L^*$  increased during the process,  $a^*, b^*, C^*, Hue^*, S^*$  decreased during fermentation phase, and RSI decreased at the end of the first day of the fermentation phase, in this phase takes place the myoglobin transformation. No statistically significant differences were found between diameters and zone except for  $L^*$ .

## INTRODUCTION

The most popular Spanish dry fermented sausage is "Chorizo" it is the second dry-cured product in economic importance. Paprika is the most important spice in "Chorizo" manufacturing and this spice gives it its special appearance.

The aim of this work is to study the influence of diameters and zones in the evolution of colour parameters during the process in a Spanish dry fermented sausage "Chorizo"

## MATERIALS AND METHODS

The "Chorizo" samples were prepared in a commercial meat plant according to usual practice. Both, meat (lean pork) and fat (back fat) were ground and thoroughly mixed with the other ingredients in a bowl chopper. Each "Chorizo", contained 65.30 % lean pork meat, 27.90 % pork back fat, 2.14% salt, 0.93% Lactose, 0.93 % Dextrose, 1.4% smoked paprika, 0.93% sweet paprika, 0.30 % phosphates, 0.03 % monohydrate garlic, 0.01% white pepper, 0.01% potassium sorbate, 0.06% sodium glutamate, 0.047 % sodium ascorbate, 0.02% potassium nitrate, 0.01 % sodium nitrite and 0.05 % marjoram. The study was made with 50 "Chorizo" samples. The "Chorizo" samples were filled in official casings with diameters of 55 and 65 mm, the "Chorizo" samples were divided in two zones (core and outer), for 55 and 65 mm the core had a 25 mm. The weights of "Chorizos" samples were 500 g approximately. The "Chorizo" samples were fermented for 2 days at 20°C, 75% RH 90-95 and then were ripened for 24 days at 12-14°C and RH % 75-80. The sausages were collected at different times : 0, 0.5, 1.5, 2, 5, 13, 20, 26 days after stuffing. The colour parameters under study were : CIE  $L^*a^*b^*$  ( $10^\circ$ , D65).  $L^*$  (Lightness),  $a^*$  (redness),  $b^*$  (yellowness),  $C^*$  (Chroma),  $Hue^*$  (hue),  $S^*$  (saturation). RSI (pigment discolouration), NI (pigment nitrosation) were measured by reflectance at RSI (R570/R650) and NI (R560/R500). All of these parameters were evaluated by a Minolta CM1000 R spectrophotometer.

## RESULTS AND DISCUSSIONS

The results of colour parameters during fermentation phase and ripening of the "Chorizo" process are showed in table 1 and 2. No statistically significant differences were found between diameters (55 and 65 mm) and zones (core and outer) for all colour parameters except to  $L^*$  values. The  $L^*$  values during the fermentation phase increased, no statistically significant differences were found between diameters and zones, in ripening the differences between diameters were statistically significant only for the "Chorizo" cores, and no differences were found for the outer zones, but if we compare the core and outer zone differences exists between for the same diameters. The evolution of  $L^*$  values during "Chorizo" process is shown in figure 1. The increase of  $L^*$  values is caused by the chemical transformation of myoglobin (Myo) to metmyoglobin (Metmyo) and nitrosomyoglobin (Myo-NO) (PALOMBO et al, 1989)". The  $a^*$  values decrease during fermentation phase, during the "Chorizo" ripening  $a^*$  was stabilized. The cause of the decreased during fermentation phase was the nitrosopigments formation (SARASIBAR et al, 1989)". The evolution of  $a^*$  during "Chorizo" process is shown in figure 2. In the fermentation phase  $b^*$  decrease, this decrease is caused by paprika pigments lability (HAMMER, 1992)", during this stage the nitrate and nitrite emphasize more this phenomena (SARASIBAR et al 1989)". Also in this stage begins the fat oxidation by microbiological action (POTTHAST, 1987)", (DEMEYER, et al 1986)", (VERPLAETSE, et al 1989)", (WISMER-PEDERSEN, 1988)", (ZERT, 1982)". The evolution of  $b^*$  during "Chorizo" process is shown in figure 3. The  $C^*$  values is generally consider for useful parameter to describe colour changes (SMULDERS et al, 1989)". The  $C^*$  values decreased during fermentation phase because in this stage takes place the transition of Myo different forms (PALOMBO et al, 1989)". The evolution of  $C^*$  during the "Chorizo" process is shown in figure 4.  $Hue^*$  values decreased during the process, this phenomena is also caused by the transition values of Myo different forms (PALOMBO et al, 1989)". The  $Hue^*$  values present the tendency, during the processing, to obtain red values ( $30^\circ$ ), meanwhile in the fermentation phase the  $Hue^*$  values are more closely to orange ( $60^\circ$ ) for paprika pigments. The evolution of  $Hue^*$  values are shown in figure 5. The  $S^*$  values present a strong decreased

during fermentation phase and the evolution of this parameter can be observed in figure 6. The NI determine the relative proportion of the Fe II native pigments and of the Fe II pigments stabilized by nitrosation, that is to say, the ratio of concentration of Myo/(Myo-No) "(GIDDEY et al, 1966) The values of NI present a decreased in fermentation phase at the end of the first day after the stuffing. The fermentation phase exhibits the best conditions for nitrosopigments formation, because 20-22°C are the best conditions for the growth of nitrate reducing microorganisms, lactic acid formation, and reduction conditions by indigenous and added reductants and it's effect on the nitrates and nitrites to generate nitrous oxide to nitrosation the Myo"(RONCALES, et al 1989) ", "(ZERT, 1982)", "(POTTHAST, 1987)", "(BALDINI, et al 1981)", "(SHAHIDI, 1989)". The evolution of NI is shown in figure 7. The RSI is a measure of the intensity of red colour bright and allows the estimation of the relative proportion of Fe II and Fe III pigments, that is to say, the ratio of concentration of Myo+(Myo-No) Metmyo."(GIDDEY et al.)". The evolution of this parameter can be observed in figure 8. The decrease observed at end of the first day of fermentation phase is due to nitrosopigments mechanism by the Metmyo formation."(DEMEYER, et al 1986)", "(POTTHAST, 1987)".

## CONCLUSIONS

Fermentation phase and ripening present different evolution for each colour parameter. The colour parameters under study in different diameters and zones showed no differences except to L\* The colour parameters evolution decreased for a\*, b\*, C\*, S\*, Hue\* during process except L\* and RSI that increased during ripening. During the "Chorizo" process takes place a colour change between fermentation phase and ripening (during the ripening colour changes do not take place). At the end of ripening stage the hue\* values tend to the red hue values. The best conversion rate in nitrosopigments takes place at the first day after the stuffing begins. The highest metmyoglobin concentration takes place at the end of the first day of the fermentation phase.

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Table 1.- Evolution of colour parameters in "Chorizos" with diameter of 55 mm during fermentation phase and ripening

	time	zone		L*	a*	b*	C*	hue*	S*	NI	RSI
FERMENTATION	0	core	X	30.55	19.68	21.63	29.24	47.69	0.95	1.87	0.37
			s.e.	1.08	2.16	2.38	3.21	0.28	0.07	0.45	0.04
		outer	X	31.32	20.67	21.04	29.60	44.53	0.96	2.07	0.40
			s.e.	1.91	3.10	4.71	5.36	3.79	0.19	0.45	0.05
	0.5	core	X	29.72	23.27	22.51	32.57	42.29	1.08	1.97	0.28
			s.e.	1.91	2.81	5.89	6.02	4.72	0.14	0.77	0.06
		outer	X	28.18	14.94	14.67	20.99	44.75	0.75	1.05	0.33
			s.e.	1.28	1.03	0.71	0.71	2.86	0.05	0.04	0.03
	1	core	X	29.01	16.28	15.25	22.34	42.96	0.77	0.95	0.27
			s.e.	0.74	1.12	1.54	1.72	2.08	-0.05	0.14	0.05
		outer	X	32.74	24.33	23.97	34.21	43.84	1.04	1.03	0.29
			s.e.	1.08	3.36	5.27	6.06	2.43	0.15	0.16	0.06
1.5	core	X	34.67	15.17	14.98	21.32	44.76	0.61	1.24	0.40	
		s.e.	1.33	3.33	3.20	4.62	0.35	0.13	0.20	0.02	
	outer	X	30.39	20.49	19.92	28.57	44.15	0.94	1.72	0.36	
		s.e.	1.75	1.51	1.64	2.23	0.32	0.06	0.18	0.01	
RIPENING	2	core	X	33.13	16.74	14.08	21.91	39.99	0.66	1.26	0.36
			s.e.	1.23	1.37	1.40	1.94	0.48	0.04	0.15	0.02
		outer	X	32.15	13.53	13.80	19.35	45.60	0.60	1.05	0.35
			s.e.	0.65	0.87	0.68	1.09	0.60	0.02	0.03	0.01
	5	core	X	40.58	14.51	13.31	19.70	42.61	0.48	1.17	0.43
			s.e.	1.72	2.42	2.14	3.22	0.77	0.06	0.14	0.01
		outer	X	36.04	15.51	12.37	19.89	38.48	0.55	1.19	0.40
			s.e.	0.35	0.53	0.82	0.93	0.87	0.02	0.06	0.01
	13	core	X	43.31	20.03	17.61	26.71	41.34	0.62	1.54	0.44
			s.e.	2.60	1.33	1.10	1.66	1.06	0.06	0.07	0.04
		outer	X	39.73	14.44	12.04	18.82	39.67	0.48	1.18	0.42
			s.e.	1.07	3.07	2.64	4.04	0.78	0.11	0.17	0.02
	20	core	X	39.23	12.44	9.61	15.76	37.84	0.40	1.01	0.42
			s.e.	1.11	0.96	0.48	0.80	2.58	0.03	0.03	0.02
		outer	X	38.33	13.35	10.61	17.06	38.65	0.44	1.07	0.41
			s.e.	1.58	1.59	1.01	1.86	0.96	0.03	0.08	0.01
	26	core	X	38.88	15.85	10.63	19.10	33.80	0.49	1.13	0.38
			s.e.	1.37	1.17	0.98	1.48	1.09	0.04	0.03	0.03
		outer	X	34.72	13.87	9.33	16.77	33.96	0.48	1.13	0.40
			s.e.	1.77	1.33	0.81	1.53	0.27	0.04	0.01	0.03

X= mean, s.e. = standard error

Table 2.- Evolution of colour parameters in "Chorizos" with diameter of 65 mm during fermentation phase and ripening

	time	zone		L*	a*	b*	C*	hue*	S*	NI	RSI
FERMENTATION	0	core	X	30.07	19.44	21.02	28.66	46.94	0.96	1.81	0.36
			s.e.	1.57	1.03	2.38	2.45	1.70	0.13	0.31	0.01
		outer	X	30.67	26.28	22.02	41.44	50.55	1.35	2.53	0.39
			s.e.	0.73	0.22	1.54	1.32	1.15	0.01	0.35	0.02
	0.5	core	X	30.14	18.16	19.15	26.39	46.58	0.87	1.72	0.40
			s.e.	0.32	1.46	1.30	1.91	0.93	0.06	0.22	0.01
		outer	X	30.88	16.04	18.70	24.67	49.96	0.80	1.36	0.35
			s.e.	0.39	3.40	2.82	4.33	2.13	0.13	0.35	0.01
	1	core	X	31.26	9.81	11.20	15.02	50.05	0.50	0.90	0.40
			s.e.	2.75	2.33	0.56	1.96	5.04	-0.12	0.03	0.06
		outer	X	31.95	18.98	19.14	27.03	44.61	0.83	1.54	0.36
			s.e.	3.43	3.99	5.26	6.43	3.10	0.14	0.56	0.07
1.5	core	X	32.32	17.14	15.71	23.29	41.67	0.72	1.21	0.33	
		s.e.	2.95	2.91	3.64	4.57	2.31	0.13	0.29	0.06	
	outer	X	31.39	14.94	15.58	20.91	44.09	0.67	1.20	0.34	
		s.e.	2.31	3.99	4.34	5.84	2.48	0.17	0.43	0.04	
RIPENING	2	core	X	34.29	12.83	12.68	18.09	44.72	0.52	1.02	0.37
			s.e.	0.64	2.35	2.24	3.22	0.21	0.08	0.19	0.01
		outer	X	32.62	16.29	14.31	21.72	41.19	0.67	1.17	0.34
			s.e.	0.84	2.52	2.42	3.50	0.49	0.11	0.15	0.01
	5	core	X	40.46	17.37	15.14	23.06	41.05	0.57	1.29	0.42
			s.e.	0.93	0.17	0.57	0.25	1.33	0.01	0.07	0.03
		outer	X	37.15	17.21	15.28	23.08	41.66	0.62	1.39	0.41
			s.e.	1.05	1.50	1.10	1.87	0.44	0.06	0.11	0.01
	13	core	X	46.10	16.16	11.66	20.28	36.87	0.44	1.04	0.45
			s.e.	0.14	2.99	0.94	2.93	4.30	0.06	0.09	0.04
		outer	X	41.59	17.10	13.77	21.96	38.84	0.53	1.26	0.42
			s.e.	0.77	0.81	0.68	1.05	0.09	0.03	0.05	0.01
	20	core	X	41.78	15.37	12.79	20.04	40.61	0.48	1.25	0.42
			s.e.	1.06	4.03	2.99	4.95	2.64	0.13	0.22	0.03
		outer	X	38.28	12.52	8.79	15.42	34.75	0.40	0.99	0.39
			s.e.	1.79	1.86	1.89	2.46	3.23	0.06	0.07	0.04
	26	core	X	41.15	17.55	14.10	22.56	38.54	0.55	1.34	0.43
			s.e.	1.07	2.08	2.17	2.95	1.15	0.06	0.13	0.01
		outer	X	41.53	15.04	12.09	19.36	38.89	0.47	1.22	0.46
			s.e.	3.30	0.78	0.21	0.47	1.92	0.04	0.03	0.02

X= mean, s.e. = standard error

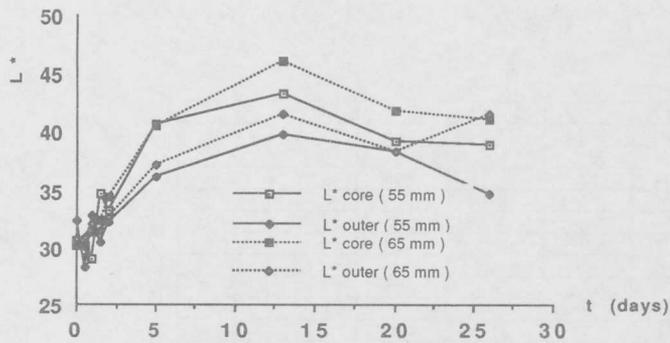


Fig. 1.- Evolution of  $L^*$  in "Chorizos" with diameters of 55 and 65 mm

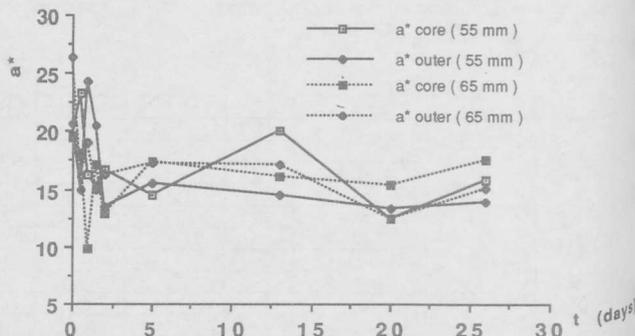


Fig. 2.- Evolution of  $a^*$  in "Chorizos" with diameters of 55 and 65 mm

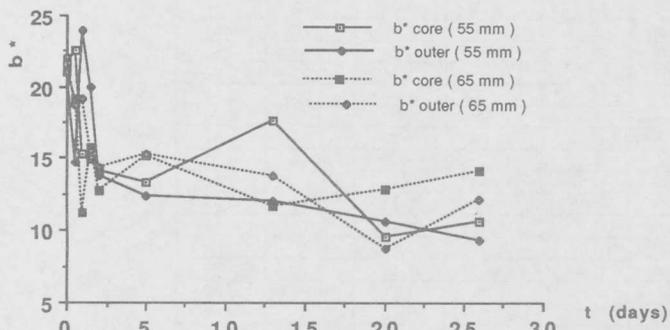


Fig. 3.- Evolution of  $b^*$  in "Chorizos" with diameters of 55 and 65 mm

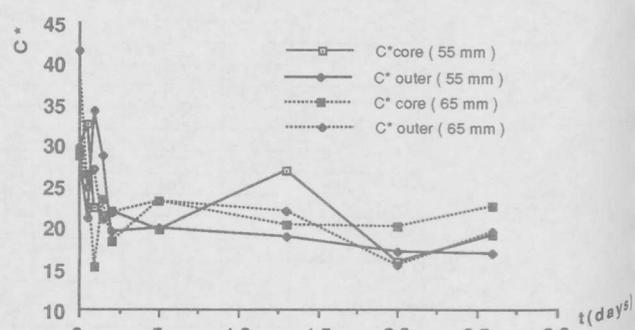


Fig. 4.- Evolution of  $C^*$  in "Chorizos" with diameters of 55 and 65 mm

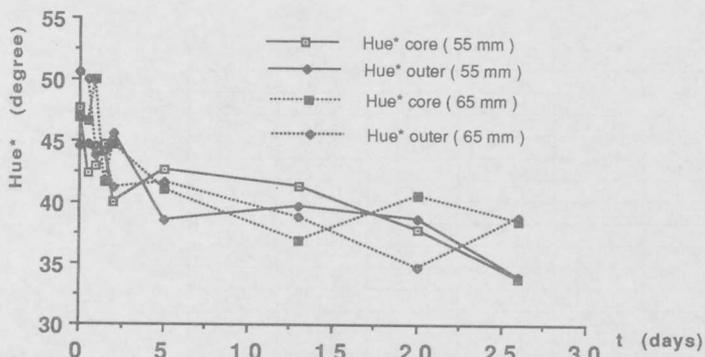


Fig. 5.- Evolution of  $Hue^*$  in "Chorizos" with diameters of 55 mm and 65 mm

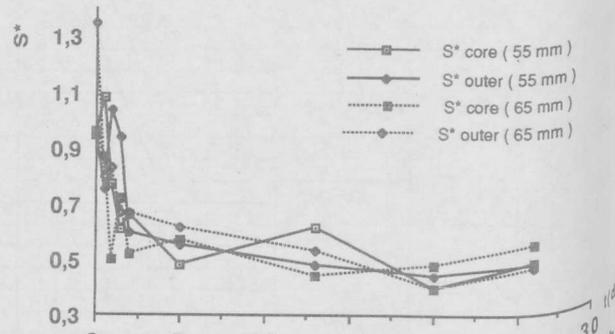


Fig. 6.- Evolution of  $S^*$  in "Chorizos" with diameters of 55 and 65 mm

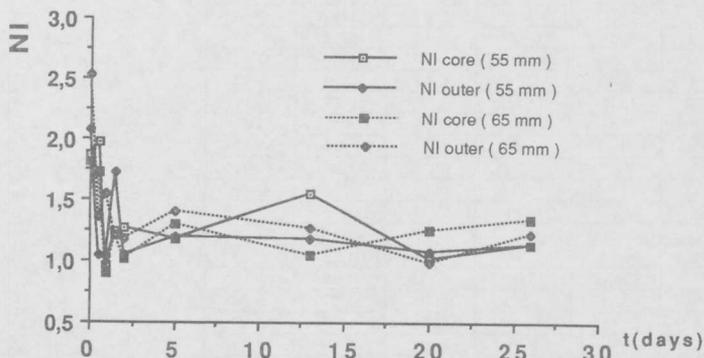


Fig. 7.- Evolution of  $NI$  "Chorizos" with diameters of 55 and 65 mm

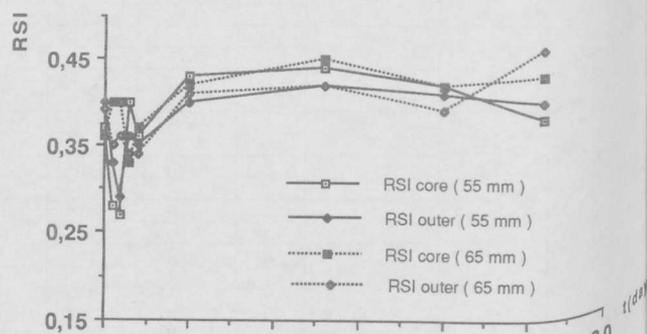


Fig. 8.- Evolution of  $RSI$  in "Chorizos" with diameters of 55 and 65 mm